2-2005

A Metaview of Metapopulations

Kirk A. Moloney
Iowa State University, kmoloney@iastate.edu

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Abstract
The notion of the "metapopulation" (or "population of populations") has been kicking around for a while. Richard Levins first introduced the term in the late 1960s, but an inkling of the biological importance of the spatial sub-structuring of species has been around much longer. In the 1960s, the island biogeography theory of MacArthur and Wilson considered the dynamic interplay of extinction and colonization in determining distributions of organisms within a fragmented (island) landscape. The idea has even earlier roots in the population genetics literature, where the idea can be traced back to the 1930s and Sewell Wright's shifting balance theory.

Keywords
ecological modeling, evolution, fragmentation, landscape ecology, metapopulation, spatial heterogeneity

Disciplines
Evolution | Other Ecology and Evolutionary Biology | Population Biology

Comments
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are only a few and they appear to be stable sites. In summary, OUP and the authors have made this a useful textbook for an undergraduate audience.

The Lowe et al. book has been designed as an upper level or graduate level textbook and a resource for researchers and will fill that niche well. In all cases its coverage is in much greater depth than the Beebee and Rowe volume and as such I found that it would be more useful to me as a reference volume. Each chapter also draws heavily on the published literature and provides citations in the text for further reading. The literature cited appears at the end of each chapter and is extensive. Lowe et al. provide excellent analyses of the finer points of the techniques that they present. This makes the material more suitable for an advanced audience and more complete. Worked examples of how to do the analyses are common and provide nice models for data analysis.

Yet, while the material is more complete, the book itself suffers from several design problems that detract from its utility. In several cases, tables are poorly designed with all text left-justified in the columns so that it is difficult for a reader to extract the important information from them. Many of the tables are crowded onto the page and it is difficult to know which information belongs in what row. I found the table that reviews data analysis software packages, Appendix A, especially hard to use. In some cases, the legends for the tables confuse the reader; for example, there is a typo in the legend for table 5.1 that informs the reader that most chloroplast and mitochondria DNA is paternally inherited. The volume depends heavily on boxes to present details but, in general, the use of boxes for supplemental information is confusing. This is especially true for Chapter 2 where the legend for Table 2.3 (which reviews the types and utility of the various markers that are available) refers the reader to Boxes 2.1–2.6 for further information. Boxes 2.1 and 2.2 occur in the middle of the chapter and do not address that topic. The material that does expand on genetic markers occurs at the end of the chapter (22 pages from the table!) and is not given a box number. Rather it occurs on gray paper and is headed "Essential methods information." In some cases, the detailed material in the box preceded the companion text material by several pages, which made me wonder why the authors thought I needed to know that now when the text was on a different topic. While none of these flaws undermine the science presented in the book they do reduce the usefulness of the book as a teaching or research tool.

I checked the publisher's website (⟨http://www.blackwellpublishing.com⟩, accessed 2 October 2004) to see if there were any other typos reported and none have been. The publisher's website says the authors will maintain a companion website with worked examples, a test question bank, and relevant links but do not provide a link to that site. A search of the senior author's website (⟨http://www.sols.uq.edu.au/index.html?page=15266&pid=14961⟩, accessed 2 October 2004) also does not provide a link. As of this writing, then, it appears that this companion site is not available.

In spite of these design problems the Lowe et al. volume is a valuable reference tool for anyone interested in this field. I can strongly recommend either book reviewed here and am encouraged that the great divide seems to be getting smaller.

VICKIE L. BACKUS

Middlebury College
Department of Biology
Middlebury, Vermont 05753
E-mail: backus@middlebury.edu

Ecology, 86(2), 2005, pp. 539–540

A METAVIEW OF METAPOPULATIONS

Hanski, Ilkka, and Oscar E. Gaggiotti, editors. 2004. **Ecology, genetics, and evolution of metapopulations.** Elsevier Academic Press, New York. xix + 696 p. $54.95, ISBN:0-12-323448-4 (acid-free paper).

Key words: ecological modeling; evolution; fragmentation; landscape ecology; metapopulation; spatial heterogeneity.

The notion of the "metapopulation" (or "population of populations") has been kicking around for a while. Richard Levins first introduced the term in the late 1960s, but an inkling of the biological importance of the spatial sub-structuring of species has been around much longer. In the 1960s, the island biogeography theory of MacArthur and Wilson considered the dynamic interplay of extinction and colonization in determining distributions of organisms within a fragmented (island) landscape. The idea has even earlier roots in the population genetics literature, where the idea can be traced back to the 1930s and Sewell Wright's shifting balance theory.

Although metapopulations as a concept was first suggested in the 1970s, serious work on metapopulation ecology didn't really gain traction until the early 1990s. This point is very nicely made in the first chapter of the book under review, where Hanski and Gaggiotti show in a clever analysis that there were virtually no citations including the key word "metapopulation" in the BIOSIS database between 1970 and 1990; this was then followed by a rapid, linear increase in citations during the 1990s. It is no coincidence then that an earlier, edited volume on metapopulations was first published in 1991 (Gilpin, Michael, and Ilkka Hanski, editors. *Metapopulation dynamics: empirical and theoretical investigations.* Academic Press, New York) and a mere decade and a half later we find the current book *Ecology, genetics, and evolution of metapopulations* (EGEM), the heft of which (xix + 696 pages) is a clear demonstration of the growth in the

field over the last decade and a half. Accentuating this growth is the almost 84 pages of references at the end of the book.

Unlike many edited books, EGEM has a uniform look and feel throughout its 23 chapters, even at the level of the figures and tables, which is no mean feat when involving so many authors. The quality of writing and information is also quite high. The book is divided into five general sections, with the middle three mirroring the overall title of the book—"Part II: metapopulation ecology," "Part III: metapopulation genetics," and "Part IV: evolutionary dynamics in metapopulations." These three sections are designed to provide an overview of the state of knowledge in each of the main topic areas.

The level of discourse varies to some extent among the three middle sections. "Part II: metapopulation ecology" is a bit more specialized in tone, with two of its three chapters focusing primarily on the development and use of stochastic patch occupancy models (SPOMs), a direction championed by the book's editors. This is not the place to begin learning about metapopulation ecology, as the treatment is quite technical, building rapidly on the basics to tackle some rather sophisticated concepts. The chapters in the sections on genetics and evolution tend to cover more of the basics. This is not to say that they only present elementary information, many (if not most) of the concepts are still quite deep and sophisticated. My guess is that the differences in treatment stem from the level of development of the metapopulation concept in each of the sub-disciplines. Metapopulation, as an explicit notion, springs from the discipline of ecology and is just now being integrated as an organizing principle into the theory of population genetics and evolution. As a consequence, there is a greater need, from the point of view of the authors in Sections III and IV, to develop a conceptual link to the idea of the metapopulation before launching into the heart of the matter.

Bookending the three central sections that form the core of the book are "Part I: perspectives on spatial dynamics" and "Part V: integration and applications." Part I serves two purposes. The first chapter, by the editors Hanski and Gaggiotti, provides a summary overview of the study of metapopulations and sets the stage for the remainder of the book. The two other chapters in the first section address a sometimes-contentious area of spatial ecology: i.e., what is the best way to characterize the spatial component of ecological interactions? Metapopulation ecology has traditionally categorized populations as existing in discrete patches of suitable habitat that are separate in space, but connected through dispersal. Practitioners of landscape ecology (the topic of Chapter 2), on the other hand, consider the influence of habitat heterogeneity on ecological processes, viewing habitats as being of varying quality, but continuous in space. Spatial ecology (the topic of Chapter 3) is yet again a different beast, being primarily concerned with how endogenous biological processes act to produce spatial heterogeneity in a homogeneous landscape. The authors of Chapters 2 and 3 ply a different course in contrasting their approaches to the one taken in metapopulation ecology. Chapter 2 considers the growing integration of the landscape and metapopulation approaches, whereas Chapter 3 takes the view that spatial ecology is suited to addressing questions that are inappropriate for the metapopulation approach and vice versa. The discussion in these two chapters is useful as it places the rest of the book within a broader context, representing various approaches to integrating the notion of space into the study of populations.

The last section of the book (Part V) is by far the largest, containing approximately half of the text and just under half of the chapters (11 out of 23). The topics covered are quite diverse and are more specialized than in the earlier portions of the book. For example, a few of the chapters take a deeper look at specific mechanisms involved in metapopulation dynamics (e.g., dispersal and extinction), others consider the metapopulation approach applied to specific areas of research (e.g., dynamics of infectious diseases, reserve design, plant-pathogen interactions), while still others explore techniques that might be applied in the study of metapopulations (e.g., viability analysis). By and large most of these chapters take a decidedly ecological approach, with only a few considering the genetic or evolutionary aspects of metapopulations. This again accentuates the different degree of integration of this conceptual idea into the three sub-disciplines of population biology considered by the book.

In summary, this is a very good book, particularly for the intended audience of graduate students and researchers wanting to know more about the consequences and rewards of viewing the world through the eyes of a metapopulationist. One major caveat, however, is that this is not a good place to start learning about metapopulations, but is instead an extremely good follow-up source for those who have learned the basics and are dying for more, perhaps with a view towards contributing to the field. It also piques one's curiosity and creates a desire to know what the equivalent book will look like a decade and a half from now.

KIRK A. MOLONEY

Iowa State University
Department of Ecology, Evolution, and Organismal Biology
Ames, Iowa 50011-1020
E-mail: kmoloney@iastate.edu